2010 On Site Review Report

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by May Shaer

Restoration of Ahmad Ibn Tulun Mosque

Cairo, Egypt

Architect
Committee of Historic Cairo Conservation / Ayman Abd Al Moneim

Client
Supreme Council of Antiquities, Egypt

Design
2000 - 2005

Completed
2005

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I. Introduction

The Mosque of Ahmad Ibn Tulun is one of the most important architectural monuments of Cairo and of the Islamic world as a whole. It dates back to the last quarter of the ninth century, and therefore belongs to the formative period of Islamic architecture. The fabric of the mosque has survived exceptionally well, especially considering its brick and plaster construction, the heavy - sometimes insensitive - uses to which it has been put over the centuries, and its location in a congested part of Cairo.

The forms and carved plaster decorative motifs of the mosque are considered amongst the finest examples of the emergent 'classical' Abbasid tradition of Islamic architecture. The mosque was built by Ahmad Ibn Tulun, who was a product of the Abbasid court in Samarra, the royal suburb of Baghdad, and it survives in much better condition than its two prototypes in Samarra, the Great Mosque and the Abu Dulaf Mosque - the largest mosques constructed in the history of Islam.

The Mosque of Ibn Tulun is consequently of extreme historical and artistic importance, and any efforts to preserve it will be followed with considerable interest by anyone involved in the study of Islamic architecture.

II. Contextual Information

A. Historical Background

The mosque was built between 876 and 879 AD. Its founder, Ahmad Ibn Tulun (r. 868-884), was appointed as Abbasid governor of Egypt, but soon asserted his independence from Baghdad and established a more or less autonomous dynasty that governed from 868 until 905, even extending its rule beyond the boundaries of Egypt to Syria.

B. Local Architectural Character

Although it had been a centre of architectural production since ancient times, Egypt had no independent architectural tradition during the early Islamic period. The Mosque of Ibn Tulun exemplifies the imperial architectural tradition that evolved under Abbasid rule. It was not until the late tenth century, during the Fatimid period, that a unique, specifically Egyptian tradition of Islamic architecture came into being.

Both brick and stone were prevalent as construction materials. The Mosque of Ibn Tulun is built of baked brick, with plaster and wood used for decorative purposes. A number of important additions and modifications were made to the mosque during the early Mamluk period, in the final years of the thirteenth century. Stone was introduced in the reconstruction

of its minaret and in the domed structure that covers the fountain at the centre of the courtyard. It also is believed that the courtyard was paved with stone for the first time then.

C. Climatic Conditions

The climate in Cairo is warm year round. Average temperatures range from 18°C in the winter to 36°C in the summer. Summers are not only hot, but also humid. Rainfall is extremely limited and does not exceed 10 millimetres a year.

In this context, it should be noted that the prayer hall of the Mosque of Ibn Tulun is completely open to the courtyard. There are no walls or doors to form a barrier between the two.

D. Site and Surroundings

The surroundings of the mosque have changed considerably over the centuries. When first built, the mosque was located in the Qata'i', the royal quarter that Ahmad Ibn Tulun had established along the edges of Fustat, Cairo's earliest Islamic settlement. The mosque is now the only surviving remnant of that quarter. It also has been argued that the western side of the mosque once bordered gardens and open agricultural land.

As the city grew, the mosque became part of its centre. Today, it is in a relatively low-income and densely occupied district that contains some important landmarks of medieval Cairo, such as the fourteenth-century Mosque of Sultan Hasan and the Cairo Citadel established by Saladin in the late twelfth century. Both are situated to the northeast of the Mosque of Ibn Tulun.

E. Topography

The surrounding area is relatively flat, though the mosque itself was built on a rather high platform known as Jabal Yashkur (which may be roughly translated as the 'mountain of the one who gives thanks'). As the level of the built fabric of the city has risen over the years, the mosque no longer towers over its surroundings.

III. Programme

A. History of the Inception of the Project

It was strongly felt amongst those working with the Islamic monuments of Cairo that the Mosque of Ibn Tulun was in need of restoration. It had suffered considerably over the years from periods of neglect and misuse. It also had structural problems, primarily as a result of serious leaks in the water and sewage networks, which had raised the water-table throughout the medieval city and undermined the foundations of many buildings to the point of near collapse. In addition, the plaster decoration of the mosque had suffered from long-term weathering and neglect and required immediate restoration and protection.

B. How were the Architects and Specialists chosen?

The project is carried out under the umbrella of the Ministry of Culture. More specifically, it is part of the Historic Cairo Conservation Project, which has brought together a number of enthusiastic and mainly young experts in conservation to protect Cairo's endangered Islamic architectural heritage. One of the main impetuses for setting up the organisation was the Cairo earthquake of 1992, which caused serious damage to a number of monuments and highlighted the urgent need to protect the city's Islamic architectural heritage.

The Historic Cairo Conservation Project was formed during the late 1990s. Being directly connected to the Minister of Culture, it has avoided many of the bureaucratic complications which affect public sector projects in Egypt (and which led to the problems of neglect and water-penetration not being properly addressed for decades).

Besides the young and dedicated team, the project involves Egyptian expertise from beyond the public sector, relying on a scientific committee made up primarily of academic experts. It seems that a close relation of constructive cooperation has evolved between the Historic Cairo Conservation Project team and the various local consultants and contractors who are pre-qualified to carry out the design and implementation of the conservation work under its supervision. Each project is developed by the project staff and advisory committee, in cooperation with one of the private sector consultants, and is then tendered out to the list of pre-qualified contractors. An approach has been evolved that ensures a level of consistency and unity across the various projects.

C. General Programme Objectives

The programme includes addressing the structural problems of the mosque as well as the deterioration of its plaster decoration. In carrying out these tasks, the restoration team has been concerned to safeguard the historical integrity of the monument. Its architectural evolution has been carefully studied, and the history of interventions thoroughly documented. The concept of reversibility is an integral part of the restoration strategy, allowing any interventions that are later deemed historically inaccurate to be easily removed. In addition, there is an emphasis on preserving the 'aged' value of the monument rather than carrying out an extensive 'face-lift' to provide it with a polished new look. In general, interventions and additions are kept to a minimum so as to preserve the structural integrity and fabric of the mosque.

In addition to these technical issues, the restoration team kept parts of the mosque accessible to worshippers and tourists, even though it would have been operationally far easier to close the whole structure for the duration of the works.

D. Functional Requirements

The mosque functions primarily as a place for Muslims to pray, but it is also an important tourist landmark. It has been carrying out this dual task successfully. Tourists visit the mosque throughout the day, but do so without interrupting the prayers in any way. In this sense, the mosque provides a positive example of cultural interaction, giving non-Muslim tourists the opportunity to observe Muslims performing their daily prayers.

IV. Description

A. Building Data

The Mosque of Ibn Tulun is a very good example of an early Islamic hypostyle mosque. It occupies an almost square site measuring about 160 metres on each side. The prayer hall is flanked by a 19-metre-wide ziyada, a walled open space that separates the mosque from the surrounding urban fabric and also traditionally contains utilitarian spaces such as ablution areas.

The prayer hall itself features five colonnades arranged parallel to the qibla wall, oriented towards Mecca. The qibla wall faces southeast. On the northwest side, the prayer hall opens directly onto a courtyard measuring 122 by 142 metres. A portico consisting of two colonnades surrounds the courtyard on the three remaining sides.

Two of the project's best-known features are believed to be the result of later additions carried out by the Mamluk Sultan Lajin (r. 1297-1299). Lajin hid in the mosque during an internal power struggle, and vowed that if he survived the episode he would embellish the mosque. The first addition is the large domed fountain structure at the centre of the courtyard. The second is the mosque's minaret, with its square base and spiral top. Lajin's minaret is located off the central axis that runs through the mosque's mihrab. It is believed to be a reconstruction based on the original minaret of the mosque, which was in turn influenced by the spiral minarets of Samarra's Great Mosque and Mosque of Abu Dulaf. Both the domed pavilion and minaret are built primarily in stone, while the rest of the structure is of baked brick.

The mosque also has a sabil (a public well) located in the southern corner of the complex. This stone structure is also attributed to Sultan Lajin.

B. Evolution of Design Concepts

As this was a conservation project, there were no new design elements apart from the ablution and office facilities that were built beyond the boundaries of the complex. The only major addition made to the structure was the paving of the courtyard. It is believed that the courtyard was not originally paved, though historical sources indicate that Lajin paved it as part of his restoration works; this pavement, however, had disappeared. When the mosque was restored by the Comité de Conservation des Monuments de l'Art Arabe in the 1920s, six orthogonal and diagonal paths were laid to connect the prayer hall and colonnade with the domed structure at the centre of the courtyard. The conservation team decided to remove these paths and cover the whole courtyard in stone, in keeping with the additions made by Lajin. They are fully aware that this decision was controversial, given that the original courtyard was not paved. However they point out that the stone paving may easily be removed if required in future, since it rests only on layers of sand, waterproofing and plain lime concrete, and does not incorporate any Portland cement or reinforced concrete. They add that the paving also allows the mosque to handle a much larger number of worshippers on Fridays and during the Muslim holidays.

In addition to paving the courtyard, most of the areas of the ziyada were covered with gravel (again, a completely reversible addition) that allows water to drain down to an open pipe network and from there to the city's sewage network. A major upgrade of the network is planned in the coming year.

C. Structure, Materials, Technology

An important component of the project has been to address the structural deterioration of the mosque. To deal with the rising water-table, drainage lines consisting of open pipe traps were dug and connected to the city's main sewage network. Before this, the penetration of water and sewage affected not only the foundations, but also the surface level, even reaching a few metres up into the walls. All of this was threatening the structural integrity of the monument.

In addition, a special high-adhesive mortar was injected in the walls to fill in cracks. A silicon-based damp-proofing was also used. Lime mortar was used between the brick courses. The restoration team has carefully avoided Portland cement and reinforced concrete in all of the restoration works. (These materials were used in the restoration works of the 1920s, with detrimental effects. A mortar containing Portland cement, for example, has a high salt content, and a different strength and elasticity than the bricks that it holds. In contrast to a lime-based mortar, it does not allow the structure to 'breathe' or 'give', resulting in serious cracks and structural deformations.)

A further challenge arising from the restoration work carried out in the 1920s was how to deal with the reinforced concrete ceiling that had replaced the original timber one (which had by then burned down). A structural survey was undertaken - though it was not an easy task, as the concrete ceiling had been paved over to provide waterproofing, and a false wooden ceiling had been suspended from its base. The survey revealed that a significant structural crack had emerged in the ceiling. Removing the ceiling was not possible in view of the permanence and irreversibility of the construction. The restoration team therefore decided that the most adequate solution would be to install stainless steel clamps to 'stitch' the crack.

The same approach applied to the re-plastering of the structure. The existing plaster decorations were documented, mechanically cleaned, strengthened, chemically cleaned and finally provided with a layer of insulation. Whenever new materials were used, a concerted effort was made to duplicate the physical and chemical characteristics of the original.

Modern ablution areas were added in the ziyada in the southern corner of the complex.

D. Origin of Technology, Materials, Labour Force, Professionals

One of the important aspects of the project is that it is primarily a local effort that effectively brings together the skills of Egyptian specialists, technicians, architects, restorers and contractors. It takes advantage of the extensive and impressive talents in conservation that exist in Egypt and, in doing so, supports an evolving Egyptian tradition of conservation that seems to be of a very high standard.

The involvement of foreigners is another interesting aspect of the project. Individual foreign specialists from countries such as Italy, France and Poland were brought in to carry out specific restoration works (such as the restoration of painted surfaces) where it was felt that local expertise was not entirely adequate. The foreigners were paired with local restorers, allowing a transfer of skills. In projects like this, foreign expertise is used when needed, but selectively. This process – being initiated at the recommendation of the scientific committee – also avoids the complex, bureaucratic and time-consuming operation of setting up bilateral agreements between the Egyptian government and a foreign government or international organisation.

V. Construction Schedule and Costs

A. History of Project Design

The planning for this and similar projects was developed during the 1990s, with a clear plan of action emerging by the late 1990s and implementation generally beginning after 2000. This project to restore the mosque was commissioned in 2000 and completed in 2005.

B. Total Costs and Main Source of Financing

The total cost of the project was around 2.5 million USD (113 USD per square metre). This is a relatively small amount considering that the mosque is one of the most important monuments of historic Islamic architecture in the world. It also is a small amount compared to the enormous resources being spent on contemporary construction projects in the region.

The funding for this project is completely local. This is important because it shows that a country such as Egypt, which generally has limited resources, is capable of financing such projects. The Egyptian government is aware that providing the necessary funding for the restoration and maintenance of its historical monuments is extremely important, not only in terms of preserving the country's heritage, but also from an economic point of view. The city's medieval and early modern heritage now forms a significant (and growing) part of tourism to Egypt. Preserving this heritage can only boost the country's tourism sector and help it diversify from the two poles of its ancient Egyptian heritage (which most western tourists visit) or its leisure opportunities (which attract tourists from neighbouring Arab countries, primarily the Gulf). If one spends any time at the Mosque of Ibn Tulun, one will come across a significant number of foreign tourists who come to visit it.

Entrance fees to historic cultural monuments now provide a significant source of revenue that could be used for their conservation and maintenance. Indeed, a good part of this income is now effectively used for such a purpose.

In addition, these conservation projects are creating decent and sustainable employment opportunities for the cadres of trained restorers that exist in Egypt.

C. Maintenance Costs

The contractor is responsible for carrying out maintenance work on the project. A yearly budget of 16,000 USD (100,000 Egyptian Pounds) is allocated for this task.

VI. Technical Assessment

A. Functional Assessment

The mosque is used as a place for prayer and also as a tourist site. It performs both functions adequately.

B. Climatic Performance, Response to Environment

Not applicable.

C. Response to Treatment of Water and Rainfall

As mentioned above, providing waterproofing and dispersing the accumulated water and sewage were primary challenges of the project, which it seems to have addressed effectively.

D. Response to, and Planning for, Emergency Situations

Mindful of the earthquake that hit Cairo in 1992, a good part of the intervention was directed at strengthening the structural system of the Mosque of Ibn Tulun to give it greater resistance to earthquakes.

E. Ageing and Maintenance

Two years after its completion, the project remains in excellent shape. As mentioned above, the contractor is responsible for carrying out maintenance on the project.

F. Impact of the Project on the Site

One of the main challenges facing the conservation efforts is that almost all of Cairo's historic monuments are located in areas of informal settlement that suffer from serious problems of overcrowding, poor municipal services, pollution and poor building practice. The project team is aware of this problem and is trying to address it in various locations (such as al-Mu'izz Street, where the whole infrastructure is being revamped and the street is being closed to traffic). The team members hope that these restoration projects will create the seeds for positive development, encouraging local people to take better care of their surroundings. In fact, there are a few signs that this is beginning to happen, even though much work still needs to be done to address the socio-economic conditions of these neighbourhoods.

It is hoped that the restoration of the mosque will provide a positive example that will lead to a general upgrading of the area around it. This is something that is definitely happening at the

Malmuk Taz Palace nearby, which has been restored and given a new use as a cultural centre. The centre hosts various free cultural activities, including exhibitions and performances of music and theatre. Interestingly enough, these are attended not only by those who follow the cultural scene in Cairo, but also by local residents who otherwise would not get the chance to participate in such activities.

G. Durability and Long-term Viability of the Project

So far, it seems that adequate maintenance is provided to ensure the long-term durability of the project.

H. Interior Design and Furnishing

The project has emphasised the concept of minimal intervention. Accordingly, almost no such additions have been made.

VII. Users

A. Description of those who use or Benefit from the Project

The project addresses many groups. For the local, primarily low-income population, the mosque is a main centre of prayer. However the mosque occupies an important position in the consciousness of all levels of Cairo society. It is the most intact of Cairo's old mosques (the Mosque of 'Amr is older, but much altered). It also is the largest mosque in Egypt. In addition, it is important in the context of the history of Islamic architecture - and will be visited by anyone with an interest in Cairo's Islamic heritage.

B. Response to Project by Clients, Users, Community

The project has been the subject of considerable controversy. It was fiercely attacked in its early stages by a number of people involved in the conservation of Cairo's Islamic architectural heritage, both local and foreign. Some of these attacks were based on a fear that it would repeat the mistakes of the insensitive conservation works that were carried before the establishment of the Historic Cairo Conservation Project. The restoration team insists, however, that their work adheres strictly to internationally accepted conservation practices.

In addition, it should be mentioned that the restoration of a monument with such a high historical and artistic value will be scrutinised very carefully, and it will be difficult to please all observers. Even if a sizeable number of specialists are completely satisfied with the work, there will always be some who consider that it has not adhered closely enough to the conservation guidelines.

Nor should be ignored the level of political infighting amongst those (both Egyptian and foreign) who are involved in the conservation of Cairo's Islamic architectural heritage. The criticism of restoration projects may often be explained within the context of such squabbles.

Interestingly, public criticism of the restoration project seems to have subsided over time. A symposium was organised in 2002 by the Ministry of Culture in association with UNESCO to discuss the issues affecting the conservation of architectural heritage of medieval Cairo and to address any fears regarding ongoing projects. It seems that the symposium defused a number of the attacks to which this and other similar projects had been subjected.

It is difficult to gauge popular reaction to the project. It seems, however, that the restoration has encouraged more people to visit the mosque than before.

The local community in turn seems to be very happy with the project since it has upgraded the area without causing major disruption to their lives.

VIII. Persons Involved

The project seems to reflect a good example of teamwork and team spirit. The Minister of Culture seems to be a major force behind this project and other similar works aimed at restoring historic Cairo. The Historic Cairo Conservation Project team - under the umbrella of the Ministry of Culture and leadership of Ayman Abd Al Moneim - carried out the work on the ground, while the project's scientific committee provided the methodological direction. Work on the ground was carried out by a large group of specialists from the project team, including Tariq Al Murri, Wagdi Abbas (site inspector), Mohmmad Abd al Hamid (site engineer) and Mohammad Yassin (site conservator). Another important aspect is that the private sector contractor who carried out the work, the Aswan Company, headed by Ahmad Hanei Mansour, functioned as an integral part of the team, and the client and the contractor engaged with each other in a very positive manner.

IX. Bibliography

Historic Cairo Conservation Project. Masjid Ahmad Ibn Tulun [The Mosque of Ahmad Ibn Tulun], Cairo: Ministry of Culture, 2004 (in Arabic).

It should be mentioned that whenever the Historic Cairo Conservation Project completes a restoration, it publishes a monograph or a brochure as a document of the work. The above monograph on the Mosque of Ibn Tulun is an example of this, and it provides a great deal of information about the monument and the conservation process.

May Shaer
April 2010

Appendix I

Issues regarding the implementation of the project for the restoration of the Millennium Mosque - Ahmad Ibn Tulun.

Project execution between 2001 and 2006

Presenting what are considered as shortcomings and breaches that took place during the actual implementation of restoration interventions at the mosque.

1. Cutting into the bedrock and insulating the courtyard (Sahn) of Ahmad Ibn Tulun Mosque

The Ahmad Ibn Tulun Mosque, including all of its additions, is known to have been constructed on top of a historical mountain, Jabal Yashkur. Laboratory tests have shown that this rocky earth has a high composition of clay minerals and veins of swelling ability.

The decision to remove the gravel layer has caused a disorder in the natural balance of the rock that had lasted several years. This is due to the fact that the gravel layer had previously acted as natural filter, helping to stabilize the humidity levels of the rocky earth and acted as an aid to the movement of water. The main item in the original bill of quantities was to pave the entire courtyard with marble tiles. This specification was later changed, whereby marble tiles were replaced by stone tiles. Hence, in order to compensate for the difference of price between marble and stone, it was agreed to create an additional item in the bill of quantities to provide insulation (damp proofing) for the rock below the courtyard, by using imported material costing 1200 Egyptian pounds per metre.

In order to implement the decision of applying a complete layer of damp proofing sheets below the entire area of the courtyard, it was required to lower the level of the rock below the ground surface around 0.50-1.00 metres in some areas. In order to achieve this, cutting into the bedrock was carried out by using electrical equipment.

The removal of the gravel layer, which had acted as a natural filter in the past, and blocking the natural breathing of the rock, has led to the accumulation of humidity as a result of the increase of the amount of water stored within the rock underneath the entire mosque area. This water mainly comes from the nearby water sources and from leakage of the water and sewage systems. Thus the humidity levels (rising damp) have increased significantly along the internal and external walls of the mosque as well as along the pillars of the four *iwans*. Additionally, the increase in the water content and humidity inside the rock could have an effect on the rate of swelling of the rock veins.

It is worth mentioning that the underground drainage system was put in place after the completion of the restoration work, the injection operations and the insulation work (water proofing), rather than prior to the onset of the delicate and precise restoration work.

2. *Injection of the external and internal walls with 'Wacker'*

The external walls of the mosque, built of brick, were injected with 'Wacker' diluted in water glass. This was carried out up to 2m in height in order to prevent the absorption of moisture. The following could be noted:

- Prior to the injection operations, there was no treatment carried out for the main source of the humidity, namely the seepage from water and sewage networks.
- Laboratory testing has shown that there is an increase in the salt content inside the walls which means that the injection with Wacker would not be effective due to the presence of salts; nevertheless injection was carried out in order to maintain the costs outlined in the bill of quantities.
- The dilution of Wacker was sometimes carried out at rates that are higher than usual, and was done by using water glass for the purpose of a higher speed of diffusion and for reducing the amount of the Wacker material used.
- This has led to the formation of a white layer over the brick walls during the execution of the project due to the closing of the pores, thus prohibiting the movement of salts and water capillarity.
- Perforations for the injections that were carried out along the brick walls were 20-30cm apart and at a height of 2.00-2.50m. Since most of these holes were not only made along the joints, but also through the brick, they have led to a weakening of the mechanical strength of the brick, causing it to crumble.
- The plastic hoses that were used during the injection process were fixed by using a gypsum mortar mix placed directly on the brick blocks, thus causing surface damage during the subsequent removal of the gypsum after injection.
- The external brick courses were changed after the injection procedure was carried out in order cover up the evidence of humidity and salts, as well as the damaged parts as a result of the drilling operations.

3. *Injection of the internal walls and pillars*

A mortar mix was injected into the interior walls and the pillars (built of red brick) at a 2.00-3.00m height with the purpose of strengthening the interior fillings of the walls. In this item, there is a contradiction between the laboratory test results and the treatment carried out:

- Laboratory tests have shown that there is an increase in humidity along those walls, reaching 90-95% in some areas. The mortar mix was composed of lime, (sand?) clay and water, all of which have the ability to react with moisture and salts inflicted from the sewage network. However, a high proportion of white cement was added in order to increase the strength of the injection mortar.
- Laboratory tests carried out on samples of the filling material inside the walls have shown that it contains clay minerals including Illite, Kaoliniteand Montmorillonite with a proportion of 41%, 34% and 25% respectively. These minerals have a high ability for water absorption and expansion. To be noted is that the original building material has lasted for 1000 years; nevertheless, it was injected with a mortar with a large proportion of water and cement added to it. This could result in increasing the swelling of the filling

material. The rate of swelling (expansion) of the material was not analyzed, nor was the potential changes to the original chemical composition.

- The lower parts of the plaster of some of the pillars were covered with a colored paint in order to conceal the evidence of moisture and salts. In other areas this was done by adding plastic material during the application of the plaster, which was reapplied several times.

4. Treatment of the brick walls by applying clay poultices for the removal of salts

The extraction of salts from the external walls and the walls of the additions (ziyada) was carried out by applying poultices composed of kaolinite, water and sand, over the surface of the brick walls.

- As previously mentioned regarding the high proportion of humidity and salts inside the walls as a result of leakage of acidic water and sulfates, the salts that are present could signify a principal component of the walls as well as the brick masonry courses.
- The application of poultices made of kaolinite, sand and water on the walls for periods exceeding six months has resulted in:
  - An increase in humidity levels by water entering the walls in addition to the water coming from the usual leakage of the sewage network.
  - An increase in the movement of water in the walls due to capillary action.
  - An increase in the speed of salt movement from inside the walls towards the surface.
  - The poultices have resulted in the extraction of a portion of salts causing the fragility of some parts - the salts originally had constituted a certain proportion of the composition of the internal filling of the walls and the brick blocks; a certain level of stability had been maintained with the natural cycles of water and salt movement.
  - The application of poultices could have resulted in dissolving some of the constituents of the internal wall filling, the brick and the joints, thus potentially causing damages in the future. Also, there is the possibility that the sand used in the poultices could lead to an increase in the salt content of the structure.
  - The washing procedure that was carried out after the application of poultices has reactivated the humidity and salts cycles.

5. Treatment of the stucco elements, including windows and niches

The stucco elements had been covered in the past with a thick layer of polymer for the purpose of protection that has resulted in yellow and grey discoloration in some areas. Analysis of this polymer layer has shown that it has merged with the stucco surface. Following are observations regarding the restoration work carried out:

- Scalpels were used to remove the top polymer layer along with the adhered decorative stucco layer, thus damaging it.
- Afterwards poultices composed of bentonite, water and ammonium bicarbonate were applied over the decorative surfaces which had already been weakened after the mechanical removal of the polymer layer. This has led to reactions within the stucco that are not visible, in addition to causing a change in its water content and the subsequent deterioration of the surface.

- As a result of using bentonite poultices following the mechanical cleaning, there was yellowish discoloration caused by bentonite that seeped through the eroded surface of the stucco. This yellowish layer was subsequently removed during the execution of the project.
- "Primal" was used to insulate (water proof) the stucco. This created a solid surface layer and could cause a change in its behavior in the future.
- New decorative stucco pieces were moulded and used for replacing the deteriorated parts, especially those overlooking the courtyard (sahn). Afterwards, a thick layer of patina was applied over the new stucco replacements, making it difficult to distinguish between the old and new parts.
- Some of the poorly executed stucco parts that had been added during past interventions were also covered over with a patina layer in order to conceal their features, rather than carrying out restoration works for them.

6. Treatment of the external and internal wall plaster

It is certain that the original bill of quantities had an item specifying the removal of all wall plastering and replacing it with a new plaster layer.

As a result of a number of objections made on this item, analyses and studies were carried out on the plaster showing that it contained cellulose and animal fiber that were used for increasing the elasticity of the material.

- A decision was taken to inject the plaster with "primal", which produces a hard acrylic layer:
  - There is no compatibility between the injected material and the plaster; the new material is stronger and harder than the plaster.
  - This would lead to the detachment of this hard layer in the future.
- With the exception of arch soffits that had decorative stucco, all of the interior plaster – whether that containing cement in its composition or not – was replaced with a new plaster consisting of a portion of white cement, without considering the historical nature of the material.
- After completing the injection operations, the plaster appeared in different hues of color. In order to conceal this, a layer of patina of dark yellowish color was applied over the interior and exterior plaster, providing the present appearance.

7. The replacement and completion of the brick masonry walls

Following the results of laboratory testing on the types of brick originally used in the construction of walls, it was expected that similar material would be used in the restoration. Analyses of the original brick has shown that the best material used in the building is the one whereby organic material was used in the manufacturing of brick, which was fired well and showing high resistivity and tolerance to humidity and salts with the least damage in comparison with the brick material that was used in previous restorations. Therefore, it was supposed that such material would be used, implying a higher cost and requiring a longer period for execution.

- Thus, it was decided to use the common brick which was brought to the site from the dismantling of nearby houses.
- In order to increase the strength of the mortar, grey cement was added to the mortar that was used for fixing the lower brick courses

8. The wooden dome over the mihrab

- The wood had been covered previously with a layer of plaster that was removed in its entirety instead of restoring it.
- 95% of the wood was replaced for faster execution of the work.

9. The wooden ceilings

The wooden ceilings that covered the reinforced concrete ceilings had damaged paint layers in addition to fungal and insect infestation. During the work progress, and in order to gain time, proper cleaning and restoration work was not carried out. On the other hand, a quick application of thick paint made of burnt clay and including stabilizing material was conducted. This provided the present dark colored thick layer over the ceilings.

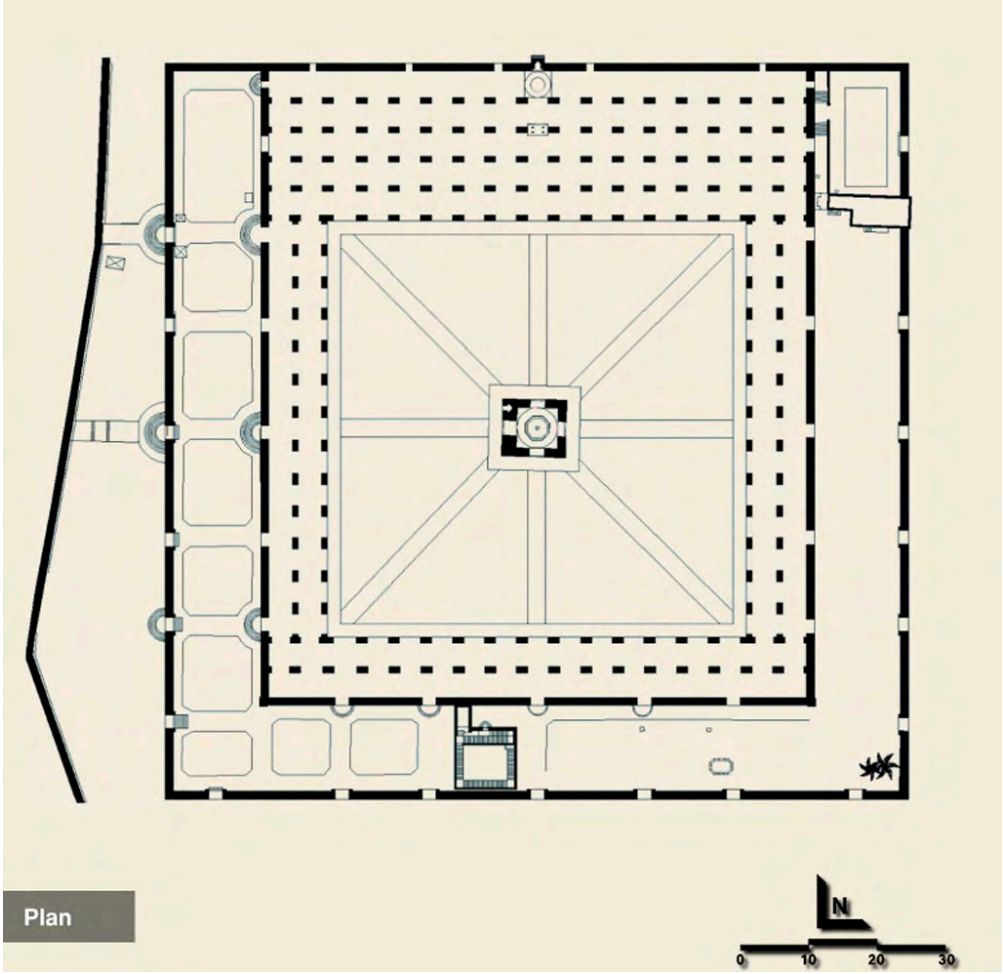
10. The main mihrab

No treatment was carried out for the main mihrab, known as the Lajin Mihrab despite the deterioration of its lower parts, especially its marble pieces. The deterioration is due to erosion, humidity and salts, in addition to the damaged stucco decoration. Nevertheless, payment was carried out in its totality for this item, under the heading of removal of soiling from the mihrab.

11. The Lajin Sabil

During the restoration of the sabil, a longitudinal well was discovered by chance, which was probably connected to a point below the sabil. Burials were surely discovered there as some skeletal remains and skulls were removed in the process of the work. The well was subsequently reburied without the necessary study or documentation.


El-Giza
Al Qahirah
Cairo, Egypt
Ahmad Ibn Tulun
Mosque


Plan
N
0
10
20
30

View of Minaret and courtyard.

View of Minaret and nortwestern Ziyada.

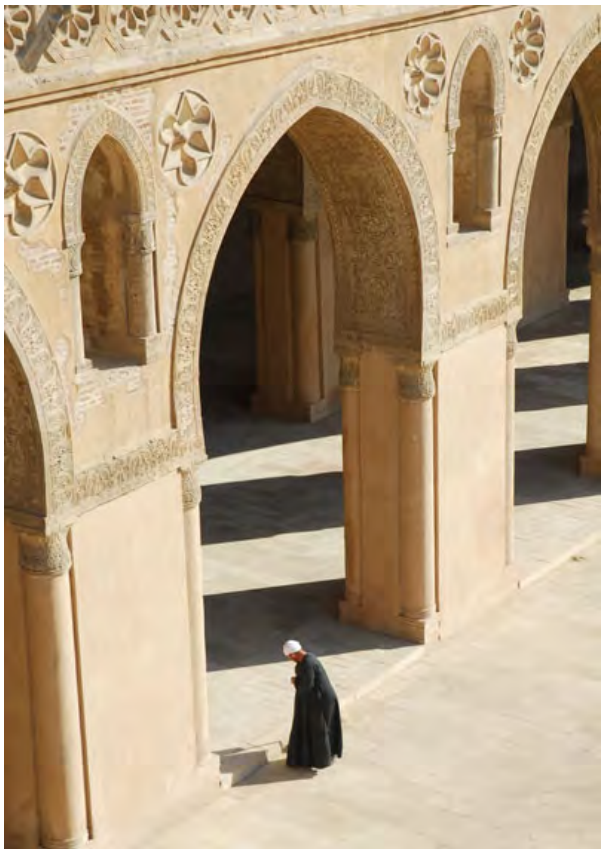
View of domed fountain structure in centre of courtyard.

View of courtyard from Minaret.

View of entrance leading to northeastern Ziyada.

Detailed view of mosque crenellations.

Detailed view of courtyard portico.



View of courtyard from courtyard portico.

Impact of the humidity.

Examples of the impact of humidity.

Attempts made for conservation maintenance.

Patching on humidity along the wall.

Conservation of the soffit arches.

White patches appearing on the wooden ceiling.

Damaged plasters on the wall.

Stones unsealled in the courtyard.

Damaged marbles.

Damaged marbles.